

REMARKS

Claims 1-55 are pending in the application.

Claims 1-55 stand rejected.

Claims 9, 12, 17, 32, 35, 48 and 51 have been amended.

Claims 56-58 have been added.

Rejection of Claims under 35 U.S.C. § 102

Claims 1-55 stand rejected under 35 U.S.C. § 102(e), as being anticipated by Uga, et al., U.S. Patent No. 6,718,326 B2 (Uga).

While not conceding that the cited reference qualifies as prior art, but instead to expedite prosecution, Applicant has chosen to respectfully disagree and traverse the rejection as follows. Applicant reserves the right, for example, in a continuing application, to establish that the cited reference, or other references cited now or hereafter, do not qualify as prior art as to an invention embodiment previously, currently, or subsequently claimed.

At the outset, Applicant respectfully notes a fundamental difference between the invention, as claimed in independent claims 1, 9, 17, 24, 32, 40 and 48, is generally directed to methods, systems network elements and so on, that employ two memories (e.g., a content-addressable memory and a multi-feature classification memory) that each store respective information regarding the processing of a packet (an index into the multi-feature classification memory, and one or more multi-feature packet processing rules, respectively). Accessing the first memory (e.g., the content-addressable memory) provides an index that can then be used to access the second memory (e.g., the multi-feature classification memory).

By contrast, Uga provides no such mechanism. In Uga's system, once a match is found in Uga's content addressable memory, actions thus identified are stored in Uga's search result storage device. Applicant respectfully submits that Uga's search result storage device does not, in fact, anticipate the claimed multi-feature classification memory for several reasons. For example, the claimed content-addressable memory does not provide any of Uga's information to the claimed multi-feature classification memory for storage therein. Moreover, Applicant respectfully submits that the claimed multi-feature classification memory does not receive anything comparable to Uga's actions and comparison information from the claimed content-addressable memory. These distinctions are highlighted by the following passages, and, Applicant respectfully submits, are sufficient to distinguish the claimed invention from Uga, and so lead to the conclusion that the claimed invention is allowable over Uga.

Claim 1 recites:

1. A method of processing a packet comprising:
populating a plurality of multi-feature packet processing rules in a multi-feature classification memory; and
populating an associated content-addressable memory with a plurality of indices of said plurality of multi-feature packet processing rules in said multi-feature classification memory.

Claims 24 and 40 recite substantially similar limitations. Claim 9, as amended, now recites:

9. A method of processing a packet comprising:
identifying a classification of said packet in a content-addressable memory; and

locating a multi-feature packet processing rule in a multi-feature classification memory using said classification.

Claims 32 and 48 recite substantially similar limitations. Claim 17, as amended, now recites:

17. A packet processing rule lookup system comprising:
a multi-feature classification memory, wherein said multi-feature classification memory is configured to store a plurality of packet processing rules for a plurality of features; and
a content-addressable memory, wherein
said content-addressable memory and said multi-feature classification memory are coupled to one another,
said content-addressable memory is configured to store a plurality of indices, and
each of said indices corresponds to at least one of said plurality of packet processing rules for a plurality of features.

Applicants respectfully note that claims 9, 12, 17, 32, 35, 48 and 51 have been amended to refine the limitations that capture the distinctions discussed herein. As will be appreciated, each of the independent claims clearly recites the fact that an index from the content-addressable memory is used to access packet processing rules for a plurality of features stored in a multi-feature classification memory. As noted earlier, this is in marked contrast to the mechanisms described in Uga.

Such an interpretation is also supported by the Specification. Sections of interest in the Specification include the following

“... ”

Introduction

The present invention describes a method and an apparatus of multi-feature lookup process using multi-feature CM in a router. In one embodiment of the present invention, the method defines various features, offered in the router, into a feature hierarchy. ***Individual associated CMs are merged into a combined associated multi-feature CM.*** The feature rules for packet processing are merged according to the feature hierarchy and the multi-feature CM is populated with the merged rules. When the router receives an incoming packet, the router searches for the incoming packet pattern for a match in a CAM bank. ***When a match is found, the router receives an index from the CAM bank for a single rule lookup in the associated multi-feature CM for packet processing. The multi-feature CM includes combined packet-processing rules for multiple features. The incoming packet is processed according to the merged rules determined by the multi-feature CM. The multi-feature CM eliminates the need for individual associated CMs. The memory space in the multi-feature CM is shared by various feature rules.***

Multi-feature Combination

Feature Hierarchy

Various features implemented in a router can be organized into a feature hierarchy. The feature hierarchy can be based on various user application related factors (i.e., e.g., per entry implementation cost, functionality, subsumability of the feature or the like). According to one embodiment of the present invention, features that require complex packet-processing rules (e.g., full functionality features such as statistics, policing, redirection or the like) and can subsume simple features (e.g., ACL or the like) are considered at the top of the feature hierarchy. Other forms of feature hierarchy are possible.

Various different features can subsume the functionality of other features. For example, typically, the ACL feature provides basic functionality of permitting or denying an incoming packet. An ACL entry requires smaller memory space to store packet-processing rule (e.g., 2 bits can provide a permit/deny decision or the like). However, a QoS entry includes complex policing scheme for the incoming packet and can requires larger of memory space to store feature parameters (e.g., type of service, select fields and the like). Similarly, a redirection feature that allows a router to redirect incoming packets to a different port requires large memory space to store feature parameters (e.g., new output port, output network address, rewrite index or the like). These features can be combined to provide a common packet-processing rule.

Complex rule entries (e.g., QoS, redirection or the like) can be used to subsume simple rule entries (e.g., ACL or the like). For example, a QoS rule typically polices the rate of incoming packets according to the characteristics of the incoming packets (e.g., specific source address, incoming port, destination address, packet type, protocol used or the like). A QoS rule can be configured to provide ACL type packet processing rule. For example, a QoS rule, 'Rule-A', can be configured to police incoming packets of type 'A' with a data rate greater than zero. The QoS rule 'Rule-A' basically denies every incoming packet of type 'A'

because every packet is received by the router with at least some data rate that is greater than zero. The QoS rule 'Rule-A' provides a functionality of an ACL rule configured to deny packets of type 'A'. In another example, a QoS rule, 'Rule-B', can be configured to police incoming packets of type 'B' with a data rate of infinity. In such case, QoS rule 'Rule-B' provides a functionality equivalent to an ACL rule permitting incoming packets with type 'B'.

Similarly, a redirection rule can be configured to redirect the incoming packets of a particular type to a drop port that drops every packet. This redirect rule provides the functionality equivalent to an ACL rule configured to deny the incoming packets of that particular type. Thus, using the combinations of features, a multi-feature CM can be configured to provide combined rules for multiple features, eliminating the need for having individual associated CMs."

(Specification, p. 4, line 1, to p. 5, line 25; Emphasis supplied)

As will be appreciated, the use of the claimed index allows the merging of individual associated CMs into a combined associated multi-feature CM, as noted in the highlighted portions, and described generally in the portions reproduced above, as well as the Specification generally. The Specification then goes on to discuss an example of a feature merge performed in accordance with the claimed invention.

Uga, by contrast, is directed to:

"A packet classification search device and method are implemented which are capable of searching rules of packet classification having very long search bit width at high speed while using a CAM which has a limited bit width. The fields of rules of packet classification are grouped into groups, and the grouped fields of

each rule are stored along with search related information (except for the initial group) and number of searches information in a CAM. The next number of searches information (if further groups exist which must be searched), comparison related information, and actions related to packets (if further groups exist which must be searched, directing searching again, while if no further groups exist which must be searched, actions for packet classification) are stored in a search result storage device. By doing this it is made possible to search with the bit width of the group unit.” (Uga, Abstract)

Using claim 1 as an example, for the purposes of this discussion, Applicant respectfully notes that the Office Action cites the first two limitations of Uga’s claim 1 as anticipating the first limitation of Applicant’s claim 1:

“1. A packet classification search device which, based upon fields included in packets which are used to classify the flow of said packets, searches through a rule table comprising a plurality of rules which combine said fields and actions to be performed in relation to packets of which the flow is classified by said fields, and determines actions to be performed in relation to said packets, comprising:

a content addressable memory which combines and stores grouped fields which have been grouped from fields included in said rules into a plurality of groups determined in advance, and number of searches information and search related information which respectively show the groups and the rules to which said grouped fields are related;

a search result storage device which stores, in correspondence to said combinations which are stored in said content addressable

memory, actions which are to be performed when combinations of grouped fields, number of searches information and search related information that have been inputted to said content addressable memory are found in said content addressable memory, and comparison related information which show the rules to search when next searching in said content addressable memory; and:

a processing device which: extracts said fields from packets which have been inputted and generates said grouped fields; inputs into said content addressable memory and searches said number of searches information and said search related information which show the groups and rules which should be searched, and said grouped fields which correspond to said groups; *obtains said actions and said comparison related information which are stored in said search result storage device in correspondence to combinations which have been searched in said content addressable memory*; and, until the details of the actions which are to be performed as said actions upon said packets are obtained, again inputs to said content addressable memory said number of searches information which shows the groups which should next be searched, said grouped fields which correspond to said groups, and said comparison related information which has been obtained, and performs said searching again.” (Uga, Claim 1; Emphasis supplied)

Applicant respectfully notes that the Office Action cites the first limitation of Uga’s claim 1 as anticipating the second limitation of Applicant’s claim 1, and the second limitation of Uga’s claim 1 as anticipating the first limitation of Applicant’s claim 1. As has been noted, Uga’s claim, and indeed, Uga’s entire disclosure, fails to anticipate the claimed invention, because Uga’s system is fundamentally different therefrom.

As is reflected in the bolded portions of Uga's claim 1, Uga's search result storage device stores the result of searching Uga's content addressable memory. This is markedly different from the claimed multi-feature classification memory, as the latter does not store "actions which are to be performed when combinations of grouped fields, number of searches information and search related information that have been inputted to said content addressable memory are found in said content addressable memory" received from the claimed content-addressable memory.

Applicant further respectfully submit that new claims 56-58 further elucidate the aforementioned distinctions. No new matter is added thereby.

Applicant submits, therefore, that independent claims 1, 9, 17, 24, 32, 40 and 48 are allowable over Uga and Applicant respectfully urges the Examiner to withdraw the §102 rejection of claims 1-55 (and, Applicant expects, claims 56-58, due to their dependency on their respective independent claims). Applicant further submits that dependent claims 2-8, 10-16, 18-23, 25-31, 33-39, 41-47 and 49-55, as well as new claims 56-58, are allowable as depending upon allowable base claims in addition to being allowable for various other reasons.

CONCLUSION

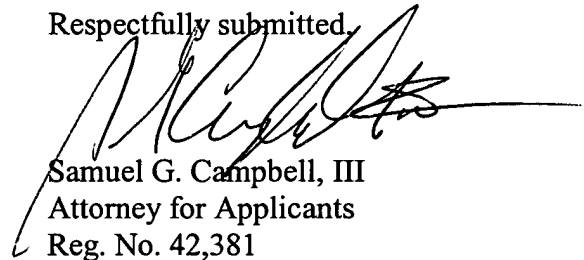
In view of the amendments and remarks set forth herein, the application is believed to be in condition for allowance and a notice to that effect is solicited. Nonetheless, should any issues remain that might be subject to resolution through a telephonic interview, the Examiner is invited to telephone the undersigned at 512-439-5084.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on February 21, 2006.


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Date of Signature

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